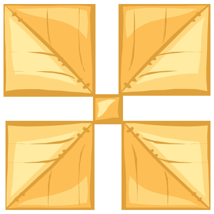
Bill Nye the Science Guy

Patterns



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Implementation Guide

Welcome to Disney's Bill Nye DVD collection!
With the help of this Guide you can bring instructional DVDs into your math curriculum.

What's on the DVD?

Bill Nye DVDs expand the educational features of *Bill Nye the Science Guy* programs. Each DVD provides students with science content through video clips aligned with *Principle and Standards for School Mathematics (PSSM)* and a host of other resources.

Short video clips aligned with the (PSSM) provide a unique opportunity for you to enhance your lessons using DVD technology. Now you can show a video clip, or even short segments of a clip, on command. But there are a host of other features, too! See the chart below for a summary.

From the Main menu, there are three chief sections:

Feature	Description
Watch Program Menu	From this menu, you can play the program straight through or use the clips to customize your viewing.
Teacher Support	From this menu, you can access this Teacher's Guide, the Glossary, Internet Links, and the Quiz.
Bonus Materials	Use this menu to try a different discussion starter, download a special screen-saver, or check out never-before-seen footage.

From the Watch Program menu, you can:

Feature	Description
Play Program	Play the entire program from start to finish.
Bilingual Mode	View the entire program or clips in English or Spanish.
Glossary Mode	Make links to Glossary terms appear during the program.
Program Overview	View the program introduction, in which Bill discusses the topic covered.
Try This	Show students demonstrating science concepts.
Bill's Demonstration	Look at a demonstration conducted by Bill Nye.
Music Video	Enjoy a short music video that summarizes the topic in an age-appropriate and entertaining manner.
Math Standards	Take advantage of short video clips from the program, which are aligned with Principles and Standards for School Mathematics.

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From the Teacher Support menu, you can:

Feature	Description
Quiz	Give students a quiz to take independently or as a class. Ten quiz items are aligned with national standards. The items are in multiple-choice or true-false format. Each wrong answer links to a standards-aligned video clip. At the end of the quiz, a scoring function reveals the number of correct initial answers.
Glossary	Check out definitions of key terms and view video clips that reinforce the concepts.
DVD Features	View a quick overview of the features found on the DVD.
Teacher's Guide	Print out or view this comprehensive Teacher's Guide in PDF format.
Internet Link	Link to the Bill Nye area of Disney's Edustation Web site, where you can find links to Internet sites related to the content of each Bill Nye program.

From the Bonus Materials menu, you can:

Feature	Description
Bonus Material	Find out what *wasn't* in the episode! In most cases, there's more of the Way Cool Scientist interview, Bill Nye outtakes, and an extra discussion starter.
Additional Clips	See trailers of related DVDs and videos.
Screen-Saver	Download this cool screen-saver for your computer.

The Planning Process

This Guide provides a Lesson Planning Worksheet (see page 15), which can assist you in setting up your instruction around a topic. The following sections of this Implementation Guide are offered to assist your planning process:

- **Determining Objectives and Linking to Standards**
- **The Learning Cycle**
  - **Explore**
  - **Apply**
  - **Extend**
  - **Assess**

Science Rules!

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Determining Objectives and Linking to Standards

1. Select content and adapt and design activities to meet student interest. The PSSM Teaching Principle states that “Selecting and using suitable curricular materials, using appropriate instructional tools and techniques…are actions good teachers take everyday.” The Principle goes on to state that, “Teaching mathematics well involves creating, enriching, maintaining, and adapting instruction to move toward mathematical goals, capture and sustain interest, and engage students in building mathematical understanding.” The Bill Nye DVD provides good mathematical content in a fun and engaging way for students of all ages.

   Each DVD contains a menu of clips that are Math aligned with PSSM. You can review the standards and their aligned clips in the Standards menu under Watch Program. Also, the Standards listed on page 10 of this Guide allow you to look at additional PSSM content standards that are addressed on the video. Since most state and local standards documents were derived from the PSSM, you will find that your local and state standards match closely with content standards in the Bill Nye DVD. Here’s an example of the content standards and clips aligned with the Bill Nye DVD entitled *Measurement*:

Mathematics Standards (PSSM) Addressed in Measurement

Measurement:
Understand measurable attributes of objects and the units, systems, and processes of measurement

- **Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems.**

  Aligned clips:

  - **1 Great moments in measurement**
  - **2 A meter is a meter wherever you are**

- **Understand relationships among units and convert from one unit to another within the system.**

  Aligned clips:

  - **3 A meter to a liter to a kilogram**
  - **4 Meter/centimeter/millimeter/micrometer**

  Apply appropriate techniques, tools, and formulas to determine measurements.

- **Select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision.**

  Aligned clips:

  - **6 Construction and airplane manufacturing**
  - **7 Bridge**

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2. Determine your objectives for the lesson and how these objectives address the standards.

Sample Objectives for *Measurement*

In this activity students will:

- **Compare the origin of the metric system with the customary system.**
- **Distinguish between standard and nonstandard measurements.**
- **Explain how meters, liters, and kilograms are related.**
- **Define the metric prefixes as based on powers of ten.**
- **Convert from one unit to another within the metric system.**
- **Measure length, volume, and mass of common objects using appropriate units.**

3. Design a learning cycle of instructional experiences and assessments for the students to engage in that will help students meet these standards. Students may be given teacher-planned investigations or may be guided to design their own investigations.

The Learning Cycle

The learning cycle is a sequence of activities that involve students in the learning process. The sequence found here is based on research from Lawson**,** Abraham, and Renner published in 1989. That has been adapted to include: Explore, Apply, Extend and Assess:

Explore:	Involves assessing students' prior knowledge and providing opportunities for students to interact with content from the video.
Apply:	Includes having students use the content learned during the Explore section in a new way that is meaningful to future learning.
Extend:	Allows students to conduct further research around an area of interest within the topic.
Assess:	Provides strategies meant to inform students and teachers about the content and processes that have been learned.

Explore

The PSSM Teaching Principle states that, "Effective teaching requires a challenging and supportive classroom learning environment." In an ideal mathematical setting, students are able to think, ask questions, solve problems, and discuss solutions with their fellow classmates and the teacher. Teachers should provide students with worthwhile mathematical tasks in a way that is intriguing to all and challenging for students with different levels of ability. Mathematics teachers need to make decisions about when and how to provide information, and "how to support students without taking over the process of thinking for them." Knowing the best time to intervene is often determined by allowing students to ask questions and to explore concepts openly.

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Assess in Order to Guide Teaching: The Program Overview or the Discussion Starter on the DVD can be used to gauge students' prior knowledge. You can use student responses to make decisions about appropriate instruction and adaptations in order to meet the needs of individual students. Assessment can be in the form of student reflections from standards-aligned video clips or answers to questions found on the science quiz. Or, as in the following example, a simple graphic organizer can facilitate a formative assessment.

Example: Graphic Organizer (page 17) from *Measurement*

1. Explain to students that as they watch clips of the Bill Nye DVD Measurement, they will be filling in a graphic organizer. Begin by having the student place a circle in the middle of a piece of paper with the phrase "metric system" in it. The circle should have two or three "spokes" coming out of it.

2. Explain to students that as they watch a clip, they should display information on the wheel in a way that makes sense to them .

3. Students can then color code their graphic organizer so that one color represents what they already know about the metric system (e.g., meter, liter, gram, etc.) and another color represents new things they have learned from watching the video clip (e.g., how a meter was first determined, etc.) Replay the clip as necessary to allow students to review sections of interest.

4. Once students have completed their graphic organizers, ask them to share what they coded as "new" information. Write these on the board. Have students write their own "working" definition of the metric system. Once students have completed their definitions, collect and review their work to assess prior knowledge.

Conduct direct vocabulary instruction in the Explore phase. Research suggests that:

- Students must encounter words in context more than once to learn them.
- Instruction in new words enhances learning those words in context.
- One of the best ways to learn a new word is to associate an image with it.
- Direct vocabulary instruction on words that are critical to new content produces the most powerful learning.

Use the DVD Glossary with the linked video clips to expose students to new vocabulary words in context, along with associated video images. You can also find a printed version of the glossary terms in this Guide on page 20.

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Example: Using the Glossary for Direct Vocabulary Instruction
Measurement

1. Present students with a brief explanation or description of the new term or phrase from the glossary. For example: “Hodometer: a measuring wheel that was an instrument used in ancient Rome to measure distance traveled or mileage.”
2. Present students with a nonlinguistic representation of the new term or phrase. Show the video clip associated with the term “hodometer.”
3. Ask students to generate their own verbal description of “hodometer.”
4. Ask students to create their own nonlinguistic representation of “hodometer.”
5. Periodically ask students to review the accuracy of their explanations and representations.

Apply

“In planning individual lessons,” the PSSM Curriculum Principle states that “teachers should strive to organize the mathematics so that fundamental ideas form an integrated whole. Big ideas encountered in a variety of contexts should be established carefully, with important elements such as terminology, definitions, notations, concepts and skills emerging in the process.” Based on the information that you gained from the Explore assessments, design appropriate activities for your students. Check the experiments listed in the Episode Guide (see page 11) for explanations of the demonstration from the Bill Nye program as well as for additional experiments designed to help apply the knowledge gained.

In the following example from Measurement the standards based video clips are used to provide background information to the students.

Example: Understanding Relationships Among Units

1. Have students begin a graphic organizer with the word “Unit” in the circle, focusing on what they already know about units of measurement.
2. Watch the following chapters from the Bill Nye DVD *Measurement:*
   - A meter to a liter to a kilogram
   - Meter/centimeter/millimeter/micrometer
3. Complete the graphic organizer with new information from the clips.
4. Give students copies of the Student Problem Solving Sheet (see page 18) and have them fill the sheet out as they conduct their activities.
5. Do the activities entitled “What’s a Centimeter on You?” and “How Much Can it Hold?” from the Measurement Episode Guide.
6. Write down any remaining questions that students have about units of measurements.

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Extend

Identify and Use Resources Outside of the School: "The school program must extend beyond the walls of the school." Each Bill Nye DVD contains resources designed to facilitate such understanding, including:

- Way Cool Scientist, found in both Watch Program and Bonus Materials, in which scientists discuss their current areas of study. This real-world connection often results in a deeper student understanding of a particular career.

- Disney's Edustation Web site, where relevant Internet links provide a starting point for students to further explore topics.

- Try these video clips, with activities parents and students can do at home. The questions generated by students from these experiences can be used as foundations from which they may conduct their own research.

- Standards-aligned video clips and Bill's demonstration video clips, which can help generate topics for further research. After viewing the clips, have students list their questions, perhaps about the most current developments in a topic. By conducting online or library research, students will find answers to their questions and will learn about a topic in greater depth.

"Problem solving is central to inquiry and application and should be interwoven throughout the mathematics curriculum to provide a context for learning and applying mathematical ideas" (NCTM, 2000). Challenging problems should be based on student interests and abilities so they explore mathematical concepts that are relevant to their lives. In the following example, students use measurement skills to solve a real life problem of local interest.

Example: Example: How Long Does it Take to Get Across My State?

Pose the question above to your students. Explain that their job will be to deterime how long it would take to traverse their state using a chosen mode of transportation. Students may choose from a variety of modes including, "walking", "skateboarding", or "riding a bike." Ask students for ideas of how to solve this problem without actually "going the distance."

Depending on their travel mode choice, students can use a stopwatch and a tape measure to determine the average speed they might go using their chosen mode. (This might need to be done as a homework assignment.) Using a map students should determine the route across the state they would like to take. Allow students to use many different routes. To vary the distances, suggest that students work with a state where they were born, or where they have once lived. Alternatively, students could expand this assignment to entire countries. Or the title could be changed to "How long does it take to get out of my state from my hometown?" for a real local context.

Once students have determined the time it would take to cross the state using their chosen mode, ask them to reconsider their answer and make it more realistic by adding time for sleep, rest, eating, etc. Instruct students to provide a rationale for these additions on the Student Problem Solving Sheet (page 18).

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Assess

Once students have solved the problem, you may choose to assess them in a number of different ways:

- By having students write about what they learned in a journal.
- By having students submit projects or reports.
- By having students take the program quiz to gauge their understanding of certain facts in the video. You can either print the quiz (found in this Guide on page 22) and have each student complete it individually or use the DVD screen version and the scoring feature for whole-class assessment.
- By designing other standards-aligned questions to augment those that are provided.

While the quiz will provide you with information about what the students have learned, it does not assess how students have processed the information. Below you will find assessment ideas that can be used to measure both content and process.

A Sample Assessment

1. Explain to students that an important aspect of mathematics is communication. Tell students that they will write a short report on their problem from (How Long Does it Take to Get Across My State?) including:
    - The state and mode of transportation you chose including illustrations
    - The method that was used to find solutions to the problem
    - Mathematical calculations for solving the problem
    - Solution(s) to the problem
    - Additions to your solution to make it more realistic
    - Rationale for these additions

2. Distribute the rubric found in the Lesson Planning Worksheet (see page 15) to students so they know how they will be assessed. Make sure that students understand the criteria found in the rubric. Before you begin you may want to allow students to make changes to the rubric so that it is more clear or makes more sense from the their perspectives.

Allow students time to prepare their report. As students complete the report, walk around the room and ask questions to assess their progress and provide input as needed.

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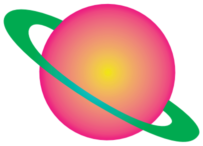
Congratulations! You have now completed the steps to set up a lesson plan using the Lesson Planning Worksheet. You have also explored many of the features of the Bill Nye DVD as well as the supplemental information found in this Teacher's Guide. And most important, you've made significant strides toward incorporating DVD technology into your day-to-day instruction.

Principles and Standards for School Mathematics (NCTM)

Patterns

Standards/Benchmarks



Algebra Standard

Understand patterns, relations, and functions

- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules;
- Describe, extend, and make generalizations about geometric and numeric patterns (3-5)

Geometry Standard

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

- Understand relationships among the angles, side lengths, perimeters, areas, and volumes of similar objects.

Use visualization, spatial reasoning, and geometric modeling to solve problems

- Recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life.

Connections Standard

- Recognize and apply mathematics in contexts outside of mathematics.

Representation Standard

- Create and use representations to organize, record, and communicate mathematical ideas;
- Use representations to model and interpret physical, social, and mathematical phenomena.

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Episode Guide

Patterns

Synopsis

In *Bill Nye the Science Guy: Patterns*, Bill Nye identifies the many patterns that fill the world around us. By venturing outside the laboratory, Bill uncovers patterns in nature, construction, the human body, and more. Many involve repetition of particular symbols or structures, and Bill explores that repetition, showing how pattersn allow for a little bit of predictability in life.

Objectives

The student will:

- be introduced to the concept of repetition in patterns;
- recognize patterns in daily life;
- examine how patterns lead to an understanding of the world around us

Background Information

Fibonacci

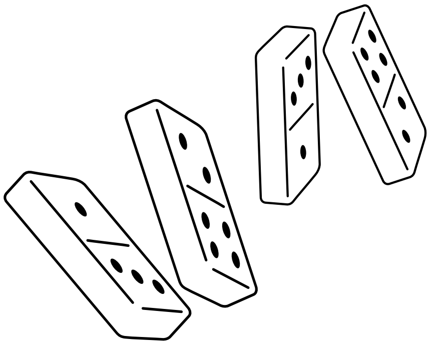
Italian-born mathematician Leonardo Pisano, who was later nicknamed Fibonacci, lived from about 1175 to about 1250 and worked with patterns in numbers. His Fibonacci sequence was derived from a problem originally dealing with the reproduction of rabbits in nature. The sequence, which begins 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, is derived by adding the two last terms to get the next term in the sequence. For instance, 0+1=1, 1+1=2, 1+2=3, and 13+21=34.

Fractals

French mathematician Benoit Mandelbrot discovered Fractal Geometry in the 1970s. Fractals are geometric shapes that are complex and identical at any scale. They are often self-similar; each portion is a reduced scale replica of the whole. Like fern leaves identified in the video, self-similar objects can be broken into pieces which will resemble the original. Fractals can be found in nature and in man-made objects, and can be produced and reproduced by adults and children alike.

Preview Questions

- What is a pattern?
- Where in nature do patterns exist?
- What are some man-made objects that follow patterns?
- What pattern does time follow?
- Does music follow any pattern?



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Postviewing Questions

- Do all patterns repeat? Give several examples that support your response.
- What causes the pattern that allows humans to observe the passage of time? Does that pattern ever change?
- What type of pattern do blind people use to “see” words? What is the name of the pattern?
- What pattern makes up music?
- How did early man use patterns to help survive?

Suggested Activities

1. Create Your Own Fractal

Have students view various fractals to help them understand how the patterns repeat (those with Internet access can visit Fractal eXtreme at http://www.cygnus-software.com/gallery/stampindex.htm).

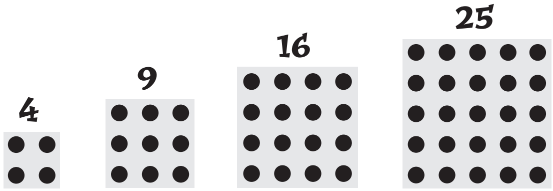
Allow students to construct their own fractals using graph paper and colored pencils, markers, or crayons. Students can use regular polygons or any geometric shapes, but should concentrate on creating a pattern. Students could also create a template or model, and then repeat the model over and over. Decorate the classroom or hallway with your students’ fractal creations.

2. Natural Fractals

Have students observe their enviromnet for fractuals that occur in nature. As a group, search your school yard, or schedule a field trip to a park, wooded area, or meadow—natural factals can even be found in a vacant lot or a neighborhood supermarket. Look at plant materals (trees and leaves, fruits and vegetables), insects (butterflies), and animal structures (beehives, anthills). Provide magnifying glasses and, if possible, microscopes, so students can identify small-scale fractals. Have students photograph or sketch the fractals. Discuss how different fractals compare to each other and to man-made examples.

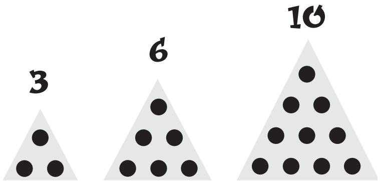
3. Geometric Dots

Mathematicians have often used dots laid out in geometric shapes to represent numbers. As the shapes grow, the number of dots grows as well. For example, square numbers look like this:



A pattern develops very rapidly with square numbers. Have students determine the pattern and then continue it for several numbers. Can they draw or explain the 25th square? The 100th? The 1000th?

Triangular numbers also form a pattern. The first three are given. Can students develop more of the pattern?



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Have students try to form a pattern for rectangular or pentagonal numbers. Drawing the figures on graph paper is often helpful.

4. Variables in Patterns

Many patterns can be explained using variables. In this activity, students must first identify a pattern and then explain it using a statement with a variable.

For example:

1 person has 4 limbs
2 people have 8 limbs
3 people have 12 limbs

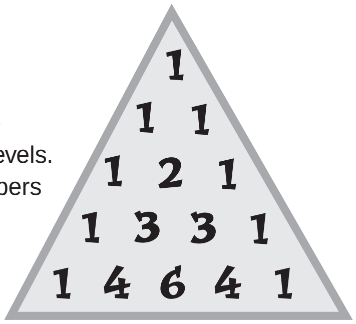
Have students notice what is similar in each example. Then have them write a statement that retains what is similar and uses a variable for what is not similar.

In this case, that would result in the statement: J people have 4J limbs (J is the variable chosen and 4J allows someone to multiply 4 times the number of people chosen, resulting in an appropriate answer for any number of people).

5. Sides and Diagonals

As the number of sides in a geometric shape increases, so does the number of diagonals. Students can work alone or in small groups to create a chart identifying the number of sides in each shape, the number of diagonals extending from each vertex (corner) and the total number of diagonals. Students should draw the first 4-6 figures to determine the pattern formed by the number of diagonals and then calculate the number of diagonals in figures with more sides. How many diagonals would there be in a shape with 20 sides? What about 30?

6. Pascal’s Triangle



Blaise Pascal, who lived in the 1600s, discovered a pattern in a pyramid of numbers. Start the triangle for your students, then ask them to determine the pattern and continue it for several levels. (The first and last number in every row is 1. The interior numbers are the sum of the two numbers just above them.)

Pascal discovered that this triangle could be used to determine probabilities. For example, if one coin were tossed, you would look at the second level of the triangle. The sum of the digits is 2. The first number shows the chance of getting 0 heads, the second the chance of getting 1 heads. In this case, 1/2 and 1/2. Continuing, if 2 coins were tossed, you could look at the third level of the triangle to determine the probability of flipping heads. If you add the numbers at this level you get 4. Then work your way across: You have a 1/4 chance of getting no heads, 2/4 of getting 1 heads, and 1/4 of getting 2 heads. Allow students determine the probability of flipping heads as more coins are tossed. Then allow them to flip real coins to see how closely the mathematical probability and reality are aligned.

7. Patterns in Fractions

Many fractions cannot be converted into decimals without resulting in an answer that repeats. These non-terminating decimals are said to be repeating, and the digits that repeat are called repetends. Some fractions follow a pattern within their repetends, others simply repeat a single digit. Have students convert fractions to decimals by dividing the numerator

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by the denominator to determine whether fractions repeat or terminate. Ask students to find fractions that have one repeating digit and more than one repeating digit.

In addition, some series of fractions follow a pattern of repeating digits. 1/7 is equal to .142857 repeating. All sevenths fractions have the same series of repeating digits, but each starts with a different digit in the series. Allow students to divide manually to determine the decimals for 1/7 and 2/7, then ask them to predict answers for the remaining fractions in the series. They should be able to reason that the next fractions would begin the series of repeating numbers with the 4, then the 5, 7, and 8. After making a hypothesis as to the order of the decimals, allow students to calculate the correct answers to check their own guesses.

Bibliography

Books

Jacobs, Harold. *Mathematics, A Human Endeavor*. , W. H. Freeman & Co., 1994.

Pappas, Theoni. *The Joy of Mathematics*. Wide World Publishing/Tetra, 1995.

Pappas, Theoni. *More Joy of Mathematics*. Wide World Publishing/Tetra, 1996.

Internet Resources

Designing Fractals
http://math.rice.edu/~lanius/frac/koch.html

Find step-by-step suggestions for making fractals as well as links to more information about fractals.

Fibonacci's Sequence
http://y.ac.uk/Personal/R.Knott/Fibonacci/fib.html

Discover more of Fibonacci's sequences and find links to mathematical mind benders.

Patterns Are Way Cool!

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Bill Nye the Science Guy

Lesson Planning Worksheet

Lesson Title

Objectives ______________________________

____

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Estimated Time Required ______________________________

Materials Needed ______________________________

____

Principles and Standards for School Mathematics

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Explore ______________________________

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Apply ______________________________

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Extend ______________________________

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Assess

As presentations are made, assess the quality of the student's work as thoroughly and as equitably as you possibly can. The following criteria can be used to assist in your assessment.

Name of Student ______________________________

Question Investigated ______________________________

Methods and Calculations for Finding Solutions			
1 Students do not report methods or calculations.	2 Students report methods or calculations but they are vague and incomplete.	3 Students report methods and calculations for solving the problem that are mostly complete.	4 Students report methods that are accurate and complete.
Solutions and Rationale			
1 Solutions are undefined. Rationale is not included.	2 Student solutions are incomplete and do not adequately answer the problem. Rationales are inaccurate.	3 Student solutions are complete and adequately answer the problem but rationale for additions are incomplete.	4 Student solutions are complete and include several detailed rationale for additions of time.
Illustrations			
1 Illustrations are not included.	2 Illustrations are adequate but do not connect well with the problem and solution.	3 Illustrations are integral to the problem and solution.	4 Illustrations are exceptional and visually engaging.

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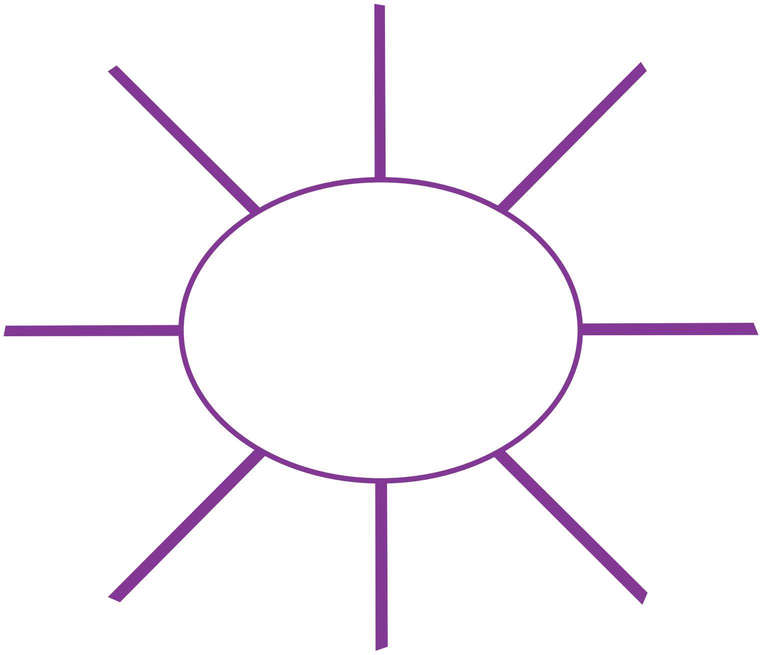
Bill Nye the Science Guy

Graphic Organizer

As you watch the Bill Nye clip, write down the main idea in the center of the circle. As supporting ideas are presented write additional words or phrases on the spokes.



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Bill Nye the Science Guy

Student Problem Solving Sheet

Problem Title: ____

Problem: ____

____

____

Method: (How you plan to solve the problem)

____

____

____

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____

____

Calculations: (Solve the problem, show your work)

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Illutstrations: (draw a picture)

What have you learned?:

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Glossary

Patterns

Fold and cut to use as flashcards.

Bill Nye the Science Guy **PATTERN**	**Pattern** A pattern can be a repeated design, sequence of objects, information, characteristics, events, or actions. Patterns help people to organize information and make predictions.
Bill Nye the Science Guy **CAMOUFLAGE**	**Camouflage** Camouflage, *meaning* disguise, contributes to animals' survival. Through colors or visual patterns, camouflage allows animals to blend in with their surroundings.
Bill Nye the Science Guy **NAUTILUS**	**Nautilus** A nautilus is a soft-bodied, spineless, ocean animal that is enclosed in a spiral shaped shell. As the nautilus grows, a new wall or compartment is added to create more room.
Bill Nye the Science Guy **DNA**	**DNA** Deoxyribonucleic acid or DNA is a spiral shaped molecule that carries genetic information. Found in the cells of all organisms, these chemical instructions or patterns are passed along from generation to generation.

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Fold and cut to use as flashcards.

Bill Nye the Science Guy **FOSSILS**	**Fossils** Fossils are pieces of evidence or traces of organisms from past ages that are preserved in earth or rock.
Bill Nye the Science Guy **EVOLUTION**	**Evolution** Evolution refers to a continuous process of change, growth and a progressive unfolding from simple to more complex. In science, evolution refers to the theory that organisms developed in a pattern over time and descended from earlier organisms, all of which originated from a *primordial soup* of chemicals considered to be the earliest building blocks of life.
Bill Nye the Science Guy **FIBONACCI SEQUENCE**	**Fibonacci sequence** Named for an Italian mathematician, the Fibonacci sequence is a pattern of numbers in which each number equals the sum of the two preceding numbers. For instance, the number sequence 0, 1, 1, 2, 3, 5, 8, 13. This sequence is evident in seashells, pinecones and flowers.
Bill Nye the Science Guy **FRACTALS**	**Fractals** A fractal is an object that has self-similarity.(for example, part of a fern that looks like the entire fern).

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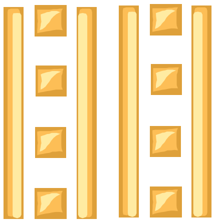
Name ______________________________ Date ______________

Quiz

Patterns

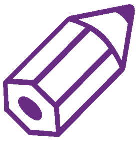


True or False? Circle T or F

1. Some patterns can help us predict the future. T or F
2. A pattern never repeats. T or F
3. Bees use a pattern of six-sided shapes to construct their honeycomb. T or F
4. A sunflower makes a rectangular pattern. T or F
5. Fibonacci sequences can be found in nature. T or F

Multiple Choice: Circle the letter of the best answer

6. Patterns can be found in:
   - A. Minerals
   - B. Bubbles
   - C. Crystals
   - D. All of the above
7. Which of the following accounts for the pattern of sunrise and sunset?
   - A. The movement of the moon
   - B. The movement of the Earth around the sun
   - C. The rotation (turning) of the Earth
   - D. The rotation of the sun
8. Which of the following statements describes the function of camouflage?
   - A. It allows animals to blend in with their natural surroundings.
   - B. It allows animals to blend in with a group so that they can not be singled out by a predator.
   - C. It allows animals to sneak up on their prey.
   - D. All of the above are functions of camouflage.
9. Why does the nautilus build new rooms in its shell?
   - A. It builds only one more wall each year.
   - B. As it gets bigger, it needs more space.
   - C. It traps prey in the new section.
   - D. It has a spiral shell and lives in the ocean.
10. Which of the following is a pattern of communication for people that cannot see?
    - A. Words on a computer screen
    - B. Patterns of raised dots
    - C. Sign language
    - D. Gestures



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Answer Key

Patterns

1. T
2. F
3. T
4. F
5. T
6. D
7. C
8. D
9. B
10. B

FIBONACCI SEQUENCE

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